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New geochemical and geochronological constraints on the origin and evolution of middle-late Eocene mafic magmatism, NE Turkey

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This study presents new $^{40}Ar/^{39}Ar$ geochronological ages, whole-rock geochemical and Sr-Nd isotopic data for the Cankurtaran mafic sill/dykes from the eastern Sakarya zone (NE Turkey) in order to decipher the origin and evolution of the final stage of Eocene magmatism in the region. $^{40}Ar/^{39}Ar$ dating for the mafic sill/dykes yielded ages ranging from ∼45Ma to ∼35Ma (i.e., Middle to Late Eocene). Based on the petrological and geochronological data, the mafic sill/dykes can be divided into three groups: Group I: Middle Eocene (∼45Ma) trachybasaltic to basaltic-trachyandesitic sill/dykes, Group II: Late Eocene (∼37 Ma) basaltic to trachybasaltic sill/dykes, and Group III: Late Eocene (∼35Ma) ultrabasic (picritic/komatitic) sill/dykes. Most of the mafic sill/dyke groups display porphyritic textures, and contain diverse phenocryst assemblages of amphibole±plagioclase (Group I), clinopyroxene±amphibole±plagioclase (Group II) and olivine± clinopyroxene (Group III) in the microcrystalline matrix consisting of plagioclase± olivine±clinopyrpxene±amphibole±Fe-Ti-Cr oxides.

Cankurtaran mafic sill/dykes have relatively high MgO contents (∼4-20%). Group III sill/dykes with 15-20% of MgO and <1% TiO_2 contents are called as komatitic and picritic basalts that have relatively low K_2O+Na_2O (<1%), Nb (∼1ppm), Zr (23-26ppm) and Y (8ppm) contents with Nb/Y ratio (∼0.1-0.2). However, the sill/dykes of Groups I and II have lower MgO contents (∼4-9%) and higher K_2O+Na_2O (∼4.5-7.5%), Nb (∼3-21ppm), Zr (94-140ppm) and Y (17-20ppm) contents with relatively high Nb/Y ratios (∼0.2-1.2). Furthermore, Groups I and II have generally alkaline composition and Group III samples are tholeiitic in composition. Based on the chondrite-normalized REE patterns, the sill/dykes generally show enrichment in LREEs and variable LREE/HREE fractionation $(La/Yb)_N$=6.2-24.5 but they have similar Eu anomalies (Eu/Eu*=∼0.9-1.0). According to the N-MORB normalized diagrams, the all mafic sill/dykes are generally enriched in LILEs and depleted in HFSEs and they display negative Nb, Hf, Zr and Ti anomalies.

All geochronological and geochemical data suggest that the Cankurtaran mafic sill/dykes formed in a post-collisional magmatic arc setting during middle to late Eocene that originated from a metasomatized lithospheric mantle source with different degrees of partial melting, which subsequently experienced fractional crystallization and minor crustal contamination.

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